

702-R-739 STRUCTURAL CONCRETE AND USE OF OPTIMIZED AGGREGATE GRADATION
IN CONCRETE

(Revised 10-20-22)

The Standard Specifications are revised as follows:

SECTION 101, BEGIN LINE 62, DELETE AS FOLLOWS:

~~GGBFS—ground granulated blast furnace slag~~

SECTION 502, BEGIN LINE 22, DELETE AND INSERT AS FOLLOWS:

502.03 Concrete Mix Design

A concrete mix design submittal, CMDS, shall be in accordance with 502.04. The CMDS shall be submitted to the DTE. The CMDS shall be submitted a minimum of seven calendar days prior to production. The CMDS shall use the Department provided spreadsheet and shall include the following:

- (a) a list of all ingredients
- (b) the source of all materials
- (c) the fine to total aggregate ratio
- (d) the absorption of the aggregates
- (e) the SSD bulk specific gravity of the aggregates
- (f) the specific gravity of pozzolan
- (g) the batch weights
- (h) the names of all admixtures
- (i) the admixture dosage rates and the manufacturer’s recommended range.

The aggregate blend ~~submitted~~ on the CMDS ~~shall~~ may produce an optimized aggregate gradation in accordance with ~~ITM 226 sections 6.2.1 and 6.3~~ the Department provided spreadsheet. ~~The aggregate blend~~ If an optimized aggregate gradation is used, it shall consist of, at a minimum, one ~~C~~concrete ~~C~~coarse A aggregate and one fine aggregate, No. 23. One additional class A or higher intermediate-sized coarse aggregate may be included if approved by the Engineer.

SECTION 502, BEGIN LINE 73, DELETE AS FOLLOWS:

502.04 Concrete Mix Criteria

Chemical admixtures type A, type B, type C, type D, type E, and type F may be allowed if shown on the CMDP. The supplied concrete mix shall include one of the following water reducing admixtures: type A, type D, type E, or type F.

(a) Portland Cement Concrete

The CMD shall produce workable concrete mixtures, with the minimum amount of water, and having the following properties.

Targets for the CMD:

Portland cement content	564 lb/cu yd ^A
Maximum portland cement content	752 lb/cu yd^A
Minimum water/cementitious ratio	0.340 ^B
Maximum water/cementitious ratio	0.435 ^B

Maximum portland cement reduction	
for slag cement replacement	30%
Slag cement/portland cement substitution ratio	1.00 by weight
Maximum cement reduction for fly ash replacement.....	20%
Fly ash/portland cement substitution ratio.....	1.25 by weight
Air Content	6.5%
Minimum modulus of rupture.....	570 psi at 7 days ^C
Relative Yield	1.00

Field Acceptance Properties:

Minimum water/cementitious ratio.....	0.320 ^B
Maximum water/cementitious ratio	0.450 ^B
Slump, <i>formed</i>	2 to 6 in.
<i>Slump, slipformed</i>	1.25 to 3 in.
Air Content	5.0% to 8.0%
Minimum modulus of rupture.....	570 psi at 7 days ^C
Relative Yield	0.98 to 1.02

^A The target cement content during production shall not be adjusted from the value stated on the CMDP.

^B The water cementitious ratio during production shall not deviate more than 0.020 from the target stated in the CMDP and shall not fall outside the limits above.

^C Beams shall be standard cured in a water tank in accordance with AASHTO T 23 and 505.01(a). The water does not need to be saturated with calcium hydroxide. Minimum flexural strength for opening to traffic shall be in accordance with 506.12.

SECTION 506, BEGIN LINE 53, DELETE AND INSERT AS FOLLOWS:

506.03 Concrete Mix Design

A concrete mix design submittal, CMDS, shall be in accordance with 506.04. The CMDS shall be submitted to the DTE. The CMDS shall be submitted a minimum of seven calendar days prior to the trial batch. The CMDS shall use the Department provided spreadsheet and shall include the following:

- (a) a list of all ingredients, including the type of CSA cement, if applicable
- (b) the source of all materials
- (c) the fine to total aggregate ratio
- (d) the absorption of the aggregates
- (e) the SSD bulk specific gravity of the aggregates
- (f) the specific gravity of pozzolan
- (g) the batch weights
- (h) the names of all admixtures
- (i) the admixture dosage rates and the manufacturer's recommended range.

The aggregate blend ~~submitted~~ on the CMDS ~~shall~~ may produce an optimized aggregate gradation in accordance with ~~ITM 226, sections 6.2.1 and 6.3~~ the Department provided spreadsheet. ~~The aggregate blend~~ If an optimized aggregate gradation is used, it shall consist of, at a minimum, one concrete coarse aggregate and one fine aggregate, No. 23. One additional class A or higher intermediate-sized coarse aggregate may be included if approved by the Engineer.

SECTION 702, BEGIN LINE 38, DELETE AS FOLLOWS:

~~Ground Granulated Blast Furnace Slag..... 901.03~~

SECTION 702, BEGIN LINE 51, DELETE AS FOLLOWS:

Grout material for field drilled holes shall be ~~either a high strength, non-shrink, non-metallic, cementitious grout in accordance with U.S. Army Corps of Engineers Specification CRD-C 621 or from the QPL of Chemical Anchor Systems.~~

SECTION 702, BEGIN LINE 64, DELETE AND INSERT AS FOLLOWS:

702.05 Proportioning

Control of PCC for air content, slump, or relative yield will be determined on the basis of tests performed by the Engineer. Concrete and necessary labor for sampling shall be furnished by the Contractor as required by the Engineer. Testing will be in accordance with the Frequency Manual.

A CMDS shall be submitted seven calendar days prior to production and be approved by the Engineer on the Department provided spreadsheet. The absolute volume of the mix design shall be 27.0 cu ft at the design air content of 6.5%.

The aggregate blend ~~submitted~~ on the CMDS ~~shall~~ may produce an optimized aggregate gradation in accordance with ~~ITM 226 sections 6.2.1 and 6.3~~ the Department provided spreadsheet. ~~The aggregate blend~~ If an optimized aggregate gradation is used, it shall consist of, at a minimum, one concrete coarse aggregate and one fine aggregate, No. 23. One additional class A or higher for exposed or class B or higher for non-exposed intermediate-sized coarse aggregate may be included if approved by the Engineer.

SECTION 702, BEGIN LINE 96, DELETE AND INSERT AS FOLLOWS:

Fly ash from a qualified source may be used as a partial replacement for portland cement. The substitution of fly ash for portland cement will not be allowed in conjunction with the use of ~~ground granulated blast furnace slag cement~~ or blended cement types IP, IP-A, IS, or IS-A. Mix designs will be based on using a maximum 20% cement reduction with a minimum 1.25:1 ash-to-cement replacement ratio, by weight.

~~Ground granulated blast furnace~~ Slag cement from a qualified source may be used as a partial replacement for portland cement. The substitution of ~~ground granulated blast furnace slag cement~~ for portland cement will not be allowed in conjunction with the use of blended cement types IP, IP-A, IS, or IS-A or fly ash. Mix designs will be based on using a maximum 30% cement substitution with a 1:1 slag-to-cement ratio, by weight.

SECTION 702, BEGIN LINE 111, DELETE AND INSERT AS FOLLOWS:

Blended portland pozzolan cements, fly ash, and slag cement may be used in concrete when the ambient temperature is above ~~50~~45°F during the entire placement period. Immediately following placement, the average ambient temperature shall be above

5045°F for the entire curing period.

SECTION 702, BEGIN LINE 132, DELETE AND INSERT AS FOLLOWS:

Class A concrete shall contain a water-reducing admixture. Class C concrete shall contain ~~either a water-reducing admixture or both a water-reducing admixture and a retarding admixture; when either the air temperature is above 70°F or the concrete temperature is above 80°F, or if~~ The types used shall not be changed during any individual contiguous pour. For class C concrete, the types of admixtures to be used shall be selected based on the expected concrete or air temperature. When either temperature is expected to be 65°F or above, both a water-reducing admixture and a retarding admixture shall be used. A water-reducing admixture shall be used when both temperatures are expected to be below 65°F unless retardation is required due to the structure design or *due to* the proposed pour sequence such as *for* the requirements for floor slab pours set out in 704.04. If class C concrete contains ground granulated blast furnace slag, the producer may propose an alternate temperature threshold for including a retarding admixture. If either class A concrete or class C concrete is used in slipformed railings, the requirement to use a water-reducing admixture is waived. Air-entraining cements will not be allowed in class C concrete.

~~The manufacturer's data, which relates recommended addition rates to ambient temperatures, shall be furnished. The proposed addition rates and adjustments to the rates, as conditions require, will be reviewed for approval using this data and the anticipated temperature. The addition rate shall not be reduced below the minimum rate recommended by the manufacturer, regardless of the concrete or air temperature. The air-entraining admixture and water-reducing retarding admixture shall be added to the batch separately. The method and equipment for adding water-reducing retarding admixture shall be as approved.~~

SECTION 702, BEGIN LINE 732, DELETE AND INSERT AS FOLLOWS:

If high-early strength cement is used, these periods may be reduced as directed. If portland-pozzolan cement, type IP or IP-A, fly ash or ~~ground granulated blast furnace slag~~ *cement* as a pozzolan is used in the structural concrete, these periods shall not apply and the removal of forms and supports shall be controlled by test beams in accordance with 702.13(h).

SECTION 702, BEGIN LINE 751, DELETE AND INSERT AS FOLLOWS:

(h) Test Beams

When portland-pozzolan cement, type IP or IP-A, is incorporated into the structural concrete elements listed below, when fly ash or ~~ground granulated blast furnace slag~~ *cement* is incorporated into the structural concrete elements listed below, or when field operations are being controlled by beam tests, the removal of forms will be allowed when the modulus of rupture reaches or exceeds the following values:

SECTION 706, BEGIN LINE 50, DELETE AS FOLLOWS:

Unless otherwise specified the slip form method may be used as a means to place concrete railing on bridge structures. If the slip form method is chosen, a signed and dated QCP shall be prepared and submitted to the Engineer for acceptance at least 15 days prior to the start of slip form barrier rail placement. The QCP shall include, as a minimum, the Contractor's concrete mix design, including materials sources and admixtures; the

Contractor's methods of materials control and testing; the Contractor's proposed method of placement, including finishing and curing; and the corrective action that will be taken when defects are found. The QCP shall also contain documentation that shows the Contractor had a successful trial demonstration of the slip form machine previously and that proper consolidation around the reinforcing bars in the wall was achieved. The slip form paver shall consolidate, screed, and finish the freshly placed concrete in one complete pass in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous railing in conformance with the plans and specifications. ~~The requirement to include a water reducing admixture in accordance with 702.05 will be waived if the railing is both slipformed and the concrete contains silica fume in accordance with 709.05(e).~~ The slump shall be 1 3/4 in. \pm 3/4 in. The joints may be formed or sawed as long as a satisfactory joint is attained. If joints are to be sawed, the full depth saw cut shall be made before uncontrolled shrinkage cracking occurs and within 48 h of concrete placement. Before full depth sawing, partial depth saw cuts of 2 1/2 in. \pm 1/2 in. at the joint locations may be made as soon as the concrete has hardened sufficiently to enable sawing without raveling. All saw cuts shall be made at the locations shown on the plans or as directed.
